SPECIFICATION

TO WHOM IT MAY CONCERN:

Be it known that we, with names, residence, and citizenship listed below, have invented the inventions described in the following specification entitled:

METHOD FOR CONSTRUCTING A FLEX-RIGID LAMINATE PROBE

Brent A. Holcombe

Residence: 1814 Rosewood Lane, Bellingham, WA 98225

Citizenship: United States of America

METHOD FOR CONSTRUCTING A FLEX-RIGID LAMINATE PROBE

Background

[0001] Attaching a Ball Grid Array ("BGA") Zero Insertion Force ("ZIF") socket onto a rigid FR-4 header with press fit pins inserted into it and then attaching that assembly to a flexible circuit using solder preforms is one previous way of providing for a Flex-Rigid-Flex probe with pins.

[0002] Another way to provide a Flex-Rigid-Flex probe with pins is to laminate a rigid PC Board to a flexible circuit board and then attach solder balls to either side of the rigid-flex laminate. A socket is then soldered to one side and a PGA header is soldered to the other side of the laminate assembly.

[0003] Both of the prior art methods of providing a Flex-Rigid-Flex interposing probe with pins unduly lengthen the bus. Further, construction of the interposing probes utilizing the above mentioned methods results in multiple reflow cycles thus increasing the likelihood of re-reflowing solder connections and creating shorts in the BGA field.

Summary

[0004] The present invention provides a method for constructing a Flex-Rigid-Flex interposing probe with pins. The method of the invention allows for reduced bus lengthening by an interposing probe and increases the electrical invisibility of the probe to the target system. Further, the method of the invention integrates the assembly of the Pin Grid Array ("PGA") socket or header with the flexible attachment into a single process containing only one reflow cycle. Still further, the single reflow cycle applies to

only one side of the flexible attachment. Still further, the method of the invention provides that SMT components near the pins in the interposing probe be soldered onto the rigid PC board as opposed to the flexible attachment. This increases the durability and reliability of the solder joints in the affected area of the probe.

[0005] The method of the invention provides a single step process for solder attaching PGA pins to a BGA header. Also, the method of the invention requires a reduced number of components. As discussed, the durability and reliability of SMT solder joints and BGA solder joints are increased.

[0006] The method of the invention also provides for ease in manufacturing a Flex-Rigid probe. The BGA socket can be soldered onto the flexible attachment at the same time as the pins and SMT components are soldered. One reflow cycle reduces the chances of re-reflowing solder balls and creating shorts in the BGA field.

[0007] The method of the invention comprises the step of first creating the lay out of the flexible attachment. Top and bottom rigid PC Boards are lain out and drilled. The drill creates holes that are the press fit diameter of nail. The holes are then plated with an annular ring on the outer exposed surface. The next step comprises laminating the flexible circuit between the two rigid PC Boards. Press fit nail pins are inserted through the holds in one side of the laminate sandwich until flush with the surface of the PC Board. Solder preforms are soldered the bottom surface of the laminate sandwich. The preforms mechanically and electrically attach the pins to the bottom rigid PC Board. A BGA socket can then be attached to the pins extending from the bottom of the laminated Flex-Rigid-Flex assembly.

Description of the Drawings

FIGS. 1A-C show a progressive view of a probe assembly during various steps of a preferred embodiment of the method of the invention.

FIG. 2 shows a side view of a flex-rigid-flex laminate probe assembly constructed in accordance with the method of the invention.

FIG. 3 shows a top view of an unetched star pattern in a flexible circuit.

FIG. 4 shows a partial side view of a single pin inserted through a flex circuit with a plurality of signal layers and ground layers.

Detailed Description

[0008] The present invention provides a simple method for constructing a pins in Flex-Rigid laminate probe. FIGs. 1A-C show a progressive view of a Flex-Rigid laminate probe assembly with pins. Referring now to FIG. 1A, a lay out of the flexible circuit is created. The flexible circuit 100 is etched. The flexible circuit layout 100 includes a variable number of inner signal layers. Each of these variable number of signal layers have a star pattern 101 left unetched. FIG. 1A shows a single row of the unetched star patterns 101 and it is understood that the flexible circuit layout 100 has a plurality of rows of unetched star patterns 101. FIG. 3 shows an enlarged top view of one of the unetched star patterns 101 in the flexible circuit layout 100. Preferably, the star pattern 101 is at a diameter slightly larger than the diameter of the nail pin to be inserted and attached to the flexible circuit 100. The star pattern 101 creates a spring contact of the signal layers with the inserted pin once the pin is inserted. FIG. 4 shows a partial side view of a single pin 102 inserted through a flex circuit 101 with a plurality

of signal layers 103 and ground layers 104. The plurality of signal layers 103 and ground layers 104 contact the nail pin 102 as allowed by the star pattern 101.

[0009] A top and bottom pair of rigid PC Boards 105 are laid out. The PC Boards are drilled with a plurality of holes in a pattern matching the plurality of star patterns 101 to a press fit diameter of the nail pin 102. It is understood that a press fit diameter allows the nail pins 102 to be inserted into the holes with a low insertion force ("LIF"). Preferably, the holes are plated with an annular ring 106 on the outer exposed surface.

[0010] Referring now to FIG. 1B, the flexible circuit 100 is laminated between the two PC boards 105. A plurality of nail pins 102 are press fit into the laminate stack 107 until the heads 108 of the nail pins 102 are flush with the surface of the top rigid PC Board105. Solder preforms (not shown) are placed over the top of protruding nail pins and reflowed to mechanically and electrically attach the pins to the bottom rigid PC Board 105. Once the plurality of nail pins 102 have been soldered into place with the solder preforms, a Ball Grid Array ("BGA") socket can be attached to the nail pin heads 108. Attachment of a BGA socket to the nail pin heads is understood by those skilled in the art.

[0011] Referring to FIG. 1C, a perspective view of a Flex-Rigid laminate assembly is shown. The flexible circuit 100 is laminated to an upper and lower rigid PC Board 105. Nail pins 102 protrude through the laminate stack 107 with the heads 108 being flush with the top rigid PC Board 105.

[0012] FIG. 2 shows an expanded sectional view of pins in a Flex-Rigid laminate structure. Flexible circuit 100 is between the two PC Boards 102. Nail pins 102 extend

through the laminate structure 107 and the heads 108 are flush with the tip PC Board 102.

[0013] While the present invention has been illustrated and described in connection with the preferred embodiment, it is not to be limited to the particular structure or steps shown. The foregoing description of the present invention has been presented for the purposes of illustration and description only. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and other modifications and variations may be possible in light of the above teachings. The embodiment was chosen and described in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and various modifications as are suited to the particular use contemplated. It is intended that the appended claims be construed to include other alternative embodiments of the invention except insofar as limited by the prior art.